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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/816,958	04/05/2004	Yukio Takigawa	042323	2429

38834 7590 12/22/2005

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EXAMINER

LE, DUNG ANH

ART UNIT	PAPER NUMBER
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2818

DATE MAILED: 12/22/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/816,958

Applicant(s)

TAKIGAWA ET AL.

Examiner

DUNG A. LE

Art Unit

2818

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☐ Responsive to communication(s) filed on ____.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-15 is/are pending in the application.
- 4a) Of the above claim(s) ____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) ____ is/are allowed.
- 6) ☒ Claim(s) 1-15 is/are rejected.
- 7) ☐ Claim(s) ____ is/are objected to.
- 8) ☐ Claim(s) ____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 05 April 2005 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some * c) ☐ None of:
- 1) ☒ Certified copies of the priority documents have been received.
 - 2) ☐ Certified copies of the priority documents have been received in Application No. ____.
 - 3) ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date ____.
- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. ____.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: ____.

DETAILED ACTION

Claim Objections

Claims 2, 4-6 and 11-15 are objected to because of the following informality:

In claim abovementioned claims, the term “ injecting “ should change to -- spraying -- in order to particularly define the subject matter which Applicants regard as the invention.

Claim Rejections

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless --

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claims 1 and 7 are rejected under 35 USC 102 (b) as being anticipated by Saito et al. (2003/0041968 A1).

Saito et al. teach a method for fabricating a semiconductor device comprising the steps of:

forming an opening in an insulation film [0004]; forming an interconnection layer of Cu as a main material in the opening [0004]; and concurrently spraying nitrogen gas and water on the surface of the interconnection layer buried in the opening [0080]

Regarding claim 7, in the step of forming the opening, the opening containing a via hole and an interconnection trench formed in a region containing the via hole is formed [0004].

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 2, 3, 6, 8, 9, 12 and 13 are rejected under 35 U.S.C. 103 (a) as being unpatentable over Saito et al. (2003/0041968 A1) in view of Ngo et al. (6,146,988).

Regarding claim 2, Saito et al. disclose the claimed invention as applied to claim 1, except for the step of forming a diffusion preventing film for preventing the diffusion of the Cu on the insulation film and the interconnection layer.

Ngo et al. teach the step of forming a diffusion preventing film for preventing the diffusion of the Cu on the insulation film and the interconnection layer (col 6, lines 40-50).

It would have been obvious to a person of ordinary skill in the art at the time the invention was made to form a diffusion preventing film for preventing the diffusion of the Cu on the insulation film and the interconnection layer in Saito's method, in order to prevent in-line Cu diffusion between closely spaced apart, thereby preventing shorting and, hence, improving the overall reliability and lifetime of the resulting semiconductor device (col 6, line 55- 60).

Regarding claim 3, the diffusion preventing film is an SiC film or a silicon nitride film (Ngo, col 6, line 48-55).

Regarding claim 8, in the step of forming the opening, the opening containing a via hole and an interconnection trench formed in a region containing the via hole is formed (Saito [0004])

Regarding claim 12, Saito in view of Ngo disclose the claimed invention as applied to claims 1- 2, except for the water to be concurrently injected with the nitrogen gas is carbonated water or ozonized water.

It would have been obvious to one having ordinary skill in the art at the time the invention was made to utilize the water to be concurrently injected with the nitrogen gas

is carbonated water or ozonized water, because it is commonly used to prevent undesirable reactions in the contact region, since it has been held to be within the general skill of a worker in the art to select a known material on the basis of its suitability for the suitable application.

Regarding claim 6, Saito et al. in view of Ngo et al. discloses the claimed invention as applied to claims 1, 2 and 3, except for the step of applying hydrogen plasmas to the surface of the insulation film and the surface of the interconnection layer.

Li et al. teach the step of applying hydrogen plasmas 38 to the surface of the insulation film 28 and the surface of the interconnection layer 36 (fig. 3, [0053]) .

It would have been obvious to a person of ordinary skill in the art at the time the invention was made to applying hydrogen plasmas 38 to the surface of the insulation film and the surface of the interconnection layer in Nabeya 's method, in order to improve the performance of the low-k dielectric in or over which the copper interconnect has been created by increasing the breakdown voltage of the low-k dielectric, resulting in improved Time Dependent Dielectric Breakdown (TDDB), removed the layer of CuO or Cu.sub.2O from the surface of a created copper interconnect, reduced the dielectric constant of the low-k dielectric in or over which the copper interconnect has been created by removing carbon from the

low-k dielectric and by thereby making the low-k dielectric more porous, and prevented damage to the surface of the low-k dielectric in or over which the copper interconnect has been created. ([0055]-[0058])

Regarding claim 9, in the step of forming the opening, the opening containing a via hole and an interconnection trench formed in a region containing the via hole is formed (Saito [0004])

Regarding claim 13, Saito in view of Ngo disclose the claimed invention as applied to claims 1, 2 and 3, except for the water to be concurrently injected with the nitrogen gas is carbonated water or ozonized water.

It would have been obvious to one having ordinary skill in the art at the time the invention was made to utilize the water to be concurrently injected with the nitrogen gas is carbonated water or ozonized water, because it is commonly used to prevent undesirable reactions in the contact region, since it has been held to be within the general skill of a worker in the art to select a known material on the basis of its suitability for the intended use.

Claim 5 is rejected under 35 U.S.C. 103 (a) as being unpatentable over Saito et al. (2003/0041968 A1) in view of Ngo et al. (6,146,988) and further in view of Li et al. (2004/0219795 A1).

Regarding claim 5, Saito et al. in view of Ngo et al. discloses the claimed invention as applied to claims 1- 2, except for the step of applying hydrogen plasmas to the surface of the insulation film and the surface of the interconnection layer.

Li et al. teach the step of applying hydrogen plasmas 38 to the surface of the insulation film 28 and the surface of the interconnection layer 36 (fig. 3, [0053]) .

It would have been obvious to a person of ordinary skill in the art at the time the invention was made to applying hydrogen plasmas 38 to the surface of the insulation film and the surface of the interconnection layer in Saito and Ngo 's method, in order to improve the performance of the low-k dielectric in or over which the copper interconnect has been created by increasing the breakdown voltage of the low-k dielectric, resulting in improved Time Dependent Dielectric Breakdown (TDDB), removed the layer of CuO or Cu.sub.2O from the surface of a created copper interconnect, reduced the dielectric constant of the low-k dielectric in or over which the copper interconnect has been created by removing carbon from the low-k dielectric and by thereby making the low-k dielectric more porous, and prevented damage to the surface of the low-k dielectric in or over which the copper interconnect has been created. ([0055]-[0058]).

Claims 4, 10, 11, 14 and 15 are rejected under 35 U.S.C. 103 (a) as being unpatentable over Saito et al. (2003/0041968 A1) in view of Li et al. (2004/0219795 A1).

Regarding claim 4. Saito et al. disclose the claimed invention as applied to claim 1, except for the step of applying hydrogen plasmas to the surface of the insulation film and the surface of the interconnection layer.

Li et al. teach the step of applying hydrogen plasmas 38 to the surface of the insulation film 28 and the surface of the interconnection layer 36 (fig. 3, [0053]) .

It would have been obvious to a person of ordinary skill in the art at the time the invention was made to applying hydrogen plasmas 38 to the surface of the insulation film and the surface of the interconnection layer in Saito 's method, in order to improve the performance of the low-k dielectric in or over which the copper interconnect has been created by increasing the breakdown voltage of the low-k dielectric, resulting in improved Time Dependent Dielectric Breakdown (TDDB), removed the layer of CuO or Cu.sub.2O from the surface of a created copper interconnect, reduced the dielectric constant of the low-k dielectric in or over which the copper interconnect has been created by removing carbon from the low-k dielectric and by thereby making the low-k dielectric more porous, and prevented damage to the surface of the low-k dielectric in or over which the copper interconnect has been created. ([0055]-[0058])

Regarding claim 10, wherein in the step of forming the opening, the opening containing a via hole and an interconnection trench formed in a region containing the via hole is formed. (Saito [0004]).

Regarding claim 11, Saito in view of Li disclose the claimed invention as applied to claim 1, except for the water to be concurrently injected with the nitrogen gas is carbonated water or ozonized water.

It would have been obvious to one having ordinary skill in the art at the time the invention was made to utilize the water to be concurrently injected with the nitrogen gas is carbonated water or ozonized water, because it is commonly used to prevent undesirable reactions in the contact region, since it has been held to be within the general skill of a worker in the art to select a known material on the basis of its suitability for the intended use.

Regarding claim 14. Saito in view of Li disclose the claimed invention as applied to claims 1 and 4, except for the water to be concurrently injected with the nitrogen gas is carbonated water or ozonized water.

It would have been obvious to one having ordinary skill in the art at the time the invention was made to utilize the water to be concurrently injected with the nitrogen gas

is carbonated water or ozonized water, because it is commonly used to prevent undesirable reactions in the contact region, since it has been held to be within the general skill of a worker in the art to select a known material on the basis of its suitability for the special purpose.

Regarding claim 15, Saito in view of Li disclose the claimed invention as applied to claims 1 and 7, except for the water to be concurrently injected with the nitrogen gas is carbonated water or ozonized water.

It would have been obvious to one having ordinary skill in the art at the time the invention was made to utilize the water to be concurrently injected with the nitrogen gas is carbonated water or ozonized water, because it is commonly used to prevent undesirable reactions in the contact region, since it has been held to be within the general skill of a worker in the art to select a known material on the basis of its suitability for the special application.

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within

TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Dung A. Le whose telephone number is (571) 272-1784. The examiner can normally be reached on Monday-Tuesday and Thursday 6:00am- 4:00 pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, David Nelms can be reached on (571) 272-1787. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 872-9306 for regular communications and (703) 872-9306 for After Final communications.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

DUNG LE
PRIMARY EXAMINER

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